Design of the Central Kentucky Parkway

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Not too many years ago, having all-weather, hard surfaced highways to all major towns in the state was a moderately ambitious goal. Yet before this goal was reached many of the roads were inadequate and it was obvious that larger, better highways were sorely needed to meet the demands of ever increasing traffic.

A limited mileage of multi-lane highways was built, only a small part with limited access, but there was no active plan for a network of modern expressways prior to the Inter-state program. The sudden materialization of a plan for some 600 miles of limited access roadway had a terrific impact upon the highway scene and prompted much serious thought on those sizeable areas which would remain reliant upon the existing out moded highways.

Since normal revenues available for road building would not be adequate to finance a large scale improvement program the Parkway system was initiated. The Mountain Parkway and the Western Kentucky Parkway are now both completed and opened to traffic adding some 200 miles of high type highways through areas which had long suffered from the lack of adequate transportation facilities.

The completion of these roads and portions of the Interstate has increased the need for additional mileage of expressways.

The most obvious need was the connecting link between the eastern terminus of the Western Kentucky Parkway and the Bluegrass.

Since the conception of the Western Kentucky Parkway there was much speculation on extending this road toward Lexington. The consensus opinion left little doubt as to whether such a road would be built, but only when it would be built. The need was obvious and public opinion was surprisingly unanimous making an early start of this Project mandatory.

The purpose of the Central Kentucky Parkway is to connect the routes converging on Elizabethtown from the south and the west–I 65 and the Western Kentucky Parkway–with the routes converging on Lexingtom from the north and east–I 75 and I 64.

The corridor selected for final route study was the natural choice–the direct route from Elizabethtown to Versailles. Before this choice was made, however, consideration was given to placing the western terminus at a point on the Kentucky Turnpike near Lebanon Junction. This decreased the required length of construction and used the existing road to descend Muldraugh Escarpment. On the negative side, the overall travel distance was increased and the travel distance from Elizabethtown to Bardstown became so great that none of this traffic would use the proposed Parkway.

At the eastern terminus consideration was given to tying into I 64 some seven miles west of Frankfort. This again reduced the required length of construction and further eliminated the crossing of the Kentucky River. As with the previous corridor, however, the travel distance to points beyond Frankfort was greatly increased.

Preliminary traffic studies made it clear that the primary traffic desires to be served were to or through Lexington, and the routes which lengthened this travel distance could not be justified as a toll facility despite the shorter length of construction required.

The corridor chosen, as noted above, offers the most direct route between our control termini and also offers a greater interior service than any of the other corridors studied.

The final route will extend 72 miles from a point on the Turnpike near Elizabethtown to a point on U. S. 60 near Versailles. Travel distance will be reduced 8 miles and travel time will be reduced 20 minutes between the terminal points.

The congestion at the interchange south of Elizabethtown where the Western Kentucky Parkway joins I 65 made it impractical to begin the Central Kentucky Parkway at this point, so the Western terminus was set on the Kentucky Turnpike approximately 0.8 mile south of U. S. 62.

The eastern terminus was set on U. S. 60 just east of Versailles. This saved construction length and the need to acquire some very expensive right-of-way. Work has been initiated to develop plans for widening and improving U. S. 60 to handle the anticipated volume of traffic.

The connection at the Kentucky Turnpike will be made with a conventional trumpet type interchange with the loop in the southwest quandrant. All movements will be provided at this location, and the major movements to and from the south are designed for 45 m.p.h. Only the inner loop providing access to the Parkway from the north is designed for a lower speed of 35 m.p.h.

The first toll plaza is located at the interchange at Kentucky 52 southwest of Boston. A barrier type plaza will intercept all traffic, through, entrance and exit, in a manner similar to that employed on the Western Kentucky Parkway. This location is complicated by the necessity to remain above the high water of the Rolling Fork River and will require an unorthodox type interchange to accomplish the design function.

Bardstown is well served by a full diamond interchange on U.S. 31E to the south and a half diamond interchange providing access to and from the east on U.S. 150 east of town.

The second toll plaza will be at the Kentucky 55 interchange south of Bloomfield. The more conventional looped diamond interchange will be used at this location.

There will be a modified diamond interchange on Kentucky 53, and the third and last toll plaza will be at the U.S. 127 interchange some 4 1/2 miles south of Lawrenceburg. This will be a conventional installation similar to that at Kentucky 55, except that U.S. 127 will be four-laned.

A half diamond interchange at Kentucky 33 south of Versailles will provide access to and from the west. The tie-in to U.S. 60 will be made by a modified trumpet providing all movements, but the left-turn movement to Versailles will be at grade due to the low anticipated volume of traffic. The major movements are designed for speeds in excess of 45 m.p.h.

The typical section consists of two 24 foot roadways with a 36 foot depressed median. The type of surface has not yet been determined, but it is anticipated that the shoulders will be full depth D.G.A. with suitable surfacing.

Design criteria for the Parkway will be as follows:

ROADWAY CRITERIA

1. Design Speed – 70 M.P.H. for the Parkway throughout.
2. Horizontal Alignment – The maximum curve shall be 3 degrees. All curves 1 degree 30 minutes and sharper shall be approached by a spiral transition as set forth in the Bureau of Public Roads "Transition Curves for Highways." A minimum distance of 500 feet shall be maintained between curves in either direc-

tion, but a minimum distance of 1000 feet shall be maintained between curves in the same direction wherever possible. All curves shall be calculated by the arc definition.

3. Vertical Alignment – The maximum grade shall be plus 4%. A minimum grade of plus 0.5% shall be maintained in all roadway ditches, both side ditch and median ditch. Where grades flatter than the above minimum are used and in all vertical curves, special attention shall be given to the ditches and median inlets shall be so spaced to maintain the minimum grade.

   The stopping sight distance shall be 750 feet and all vertical curves shall provide for this, with the minimum allowable vertical curve being 400 feet in length.

4. Clearance – Vertical clearance shall be as follows:

Parkway under any	16.25 feet
Parkway over Interstate	16.25 feet
Parkway over Primary	15.0 feet – Desireable
and Secondary	14.5 feet – Minimum
Parkway over Railroad	22.5 feet – Minimum

5. Superelevation – Table 1 set forth the amount of superelevation for the various curves and the length of transition required. The method of superelevation is shown in Drawing 2-203.6A in the Department's "Manual of Instructions for Highway Design."

TABLE 1
RATE OF SUPERELEVATION AND
LENGTH OF TRANSITION

D	S. E. in ft. per ft.	L Ft.
0°15'	N. C.	0
0°30'	N. C.	0
0°45'	0. 020	200
1°00'	0. 028	200
1°15'	0. 035	200
1°30'	0. 042	200
2°00'	0. 055	250
2°30'	0. 069	350
3°00'	0. 083	400

Note: N. C. = Normal Crown
Below horizontal line the transition shall be accomplished by a spiral curve.

6. Right-of-Way – No uniform minimum width of right-of-way shall be maintained. In all cases the right-of-way line shall be kept a minimum of 20 feet beyond construction limits and right angle breaks shall be avoided.
7. Side Roads – All side roads and cross-roads shall conform to the "Minimum Geometric Standards" of the Department of Highways, latest revision, except that no fill slopes steeper than 2:1 shall be used on any road crossing over the Parkway.

8. Frontage Roads – All frontage roads shall conform to the above standards or to Drawing 2-901.2A in the Department's "Manual of Instructions for Highway Design."
9. Interchanges – The types of interchanges to be used at the various locations will be determined by the class of road involved, the anticipated traffic and the method of toll collection used. A minimum radius of 230 feet shall be used for ramps, regardless of shape. Terminal details will conform to the latest standards of the Department. Maximum grade on the ramps will be plus 5%. However, flatter grades are recommended if they can be used without adding excessive length to the ramps.

DRAINAGE CRITERIA

1. Drainage Areas – The basis of determining drainage areas is as follows:

Sizes	*Source*
Over 10,000 Acres	County Maps
Over 75 Acres	U.S.G.S. Topographic Maps
Over 50 Acres	U.S.G.S. Multiplex Maps
Under 50 Acres (1)	Aerial Photos or Field Traverse

(1) In extremely flat terrain, it will be necessary to make field traverse of all areas less than 50 acres.

2. Return Period – Cross drainage and roadway drainage for the Toll Road shall be based on the following frequencies:

Bridges	50 Yr. Design	100 Yr. Check
Culverts	25 Yr. Design	100 Yr. Check
Roadway Drainage	10 Yr. Design	

3. Design Discharge – The rational formula as revised by Mr. J. O. Cornell will be the basis of determining design discharge for all cross drainage. The minimum time of concentration to be used is 8 minutes. The value of C shall be as shown on the map of "Average Values of C" for the State of Kentucky, with consideration given to specific site conditions. In addition, analysis of existing channel and existing structure should be made to supplment the theoretical discharge. In culvert and bridge size areas more consideration should be given to the channel analysis rather than the theoretical discharge. The slope-area method of design discharge determination as defined in the "Manual of Drainage" is recommended for the larger areas encountered. This approach may be also used to supplement other methods and data employed by the Engineer to determine a peak discharge. Records of gaging stations should be obtained where available and evaluated for selecting a design discharge.
4. Cross Drainage – This includes all pipe culverts, reinforced concrete box culverts, reinforced concrete arches and bridges used to carry surface water across the roadway.
   a. Pipe culverts may be used in diameters of 18 inches through 84 inches in increments of 6 inches. No pipes shall be used under more than 65 feet of cover, and pipes less than 24 inches in diameter shall not be used under more than 30 feet of cover. In cases where unusual bedding conditions or other factors require the use of one type of pipe, it should be so specified. At all locations requiring a pipe culvert 54 inches or greater, a comparative cost estimate will be prepared considering all pertinent items showing the relative cost of the proposed pipe to a reinforced concrete box culvert with approxi-

mately the same waterway opening, also included should be the hydraulic analysis reflecting the conditions at the site when each type of culvert is subjected to the design discharge.

b. The choice of a box culvert, arch or bridge will depend upon waterway opening required, the height of fill, foundation conditions and site characteristics at each installation. In many instances the choice will be obvious while in others it will be necessary to make cost comparisons to select the most economical structure. Size limitations on box culverts shall be a minimum size of 4 feet x 4 feet and a maximum size of 16 feet x 12 feet. Multiple culverts will undoubtedly be used in some cases, however, they should be avoided whenever possible. A minimum freeboard of 2 feet shall be maintained to high water under all bridges.

It is believed that there are sites along the line traversed by the Central Kentucky Parkway where the use of culverts designed specifically to flow full can be effectively employed. Giving due consideration to all pertinent design characteristics, recent research and practices, the Section Engineer is encouraged to propose construction of this type of conduit where warranted. The presentation of performance curves comparing operations of one or more sizes of standard culverts and corresponding sizes of culverts specially designed to flow full should be included as part of the hydraulic calculations for design.

5. Roadway Drainage– This includes roadway ditches, median ditches, inlets, storm sewers, underdrains and gutters. The runoff will be estimated by the standard rational formula using an intensity of 4 inches per hour and using a weighted C value determined by the specific conditions. Depth of flow in the side ditches shall be limited to 0.25 foot below the bottom of the base stone.

Spacing of median inlets shall be as follows:

Grade	*Inlet Spacing*
0.5%	700 feet
1.0%	1000 feet
1.5%	1000 feet
2.0%	1000 feet
2.5%	1000 feet
3.0%	1000 feet
3.5%	1000 feet
4.0%	1000 feet

On grades of 2.5% and greater spacing may be increased 1500 feet where conditions warrant, however, 1000 feet should be considered the normal maximum spacing. On grades below 2.5% the spacing may be increased where warranted by using the Type A paved ditch to maintain a maximum depth of flow of 1.0 foot.

A minimum grade of 0.5% shall be maintained in all roadway and median ditches. This will require special design in all vertical curves and in all cases where the Parkway grade is flatter than 0.5%.

At the Turnpike terminus lies on top of the Mississippian Plateau just back of the Muldraugh Escarpment. Only light earthwork will be encountered until the descent of the escarpment where limestone and siltstone will be encountered as well as some thin layers of shale. Limestone will predominate in most cuts through the rest of Hardin County and through Nelson County. The amount

of shale encountered will increase as the road progresses eastward in Nelson and Washington Counties until the limestone disappear and Eden shales predominate. Cuts in the western part of Anderson County will be entirely in Eden shale and limestone will not be encountered again until the line approaches the Salt River. From this point eastward the limestone occur increasing with the shale. The west approach of the Kentucky River will be excavated through massive limestone of good quality. The earthwork in Woodford County will be lighter than to the west, and all rock excavation will be through limestone.

Much of the rock encountered should lend itself well to pre-splitting and it is our intent to use this method extensively. It is anticipated that pre-splitting will be specified for most, if not all, the rock cuts in Hardin and Nelson Counties. Some cuts in Washington County may be pre-split. In the extreme eastern part of Anderson County most particularly for the bridge approach pre-splitting will be specified and the rock cuts in Woodford County will be so specified.

Wherever pre-splitting is specified, backslopes will be 1:20 or 1/4:1 depending upon the quality of the rock. Pre-splitting will be a pay item measured in square yards of face area projected on a vertical plane. The limit of pay excavation will be one foot behind the established backslope and no allowance will be made for breakage.

Backslopes for all cuts in Eden shale will be 2:1. This should reduce the tendency of this material to slide after being excavated. Particular attention will be given to the embankment foundation in the shale areas and extensive benching and sub-surface drainage will be used for stabilization.

Cuts in mixed materials and harder shales will be treated individually with slopes between 1/4:1 and 1:1.

Design surveys for this Project began in August of 1963. There are five firms of consulting engineers retained for the detailed design and construction supervision of sections of approximately equal volume varying in length from 9 to 16 miles. These firms from west to east are:

Johnson, Depp and Quisenberry
H. A. Spalding Engineers
Adam K. Grafe and Associates
Atlas Engineering Associates
Smith-Pollitte and Associates

Grade and Drain contracts for the entire 72 miles will be let this spring. There will be from 15 to 20 contracts, including separate sub-structures and super-structure contracts for the Kentucky River Bridge.

The schedule on this Project is extremely tight and requires close coordination of all phases of the work. Title searches and preliminary appraisals were made from the preliminary right-of-way strip maps at a relatively early stage in the proceedings. Now, when final right-of-way plans and deeds become available final appraisals and negotiations can proceed quickly.

This is somewhat at variance with normal procedures, and requires some duplication of effort on the part of the appraisers. It has worked very well to date, however, the time saved by this method is essential to maintain the proposed schedule.

There are some fifty bridges on this Project including an unusual number of major stream crossings. These include the Rolling Fork River, three crossings of Beech Fork, two crossings of the Chaplin River, the Salt River and the Kentucky River.

Most of the bridges will be cast in place reinforced concrete deck girder

bridges of the familiar type. The Kentucky River Bridge is the only major structure and it will be a welded plate girder with 130 feet simple 220 feet–320 feet–220 feet continuous, 184 feet simple spans and an overall length of 1,088 feet. This bridge will be approximately 160 feet above normal pool and the deepest footing is anticipated to be some 30 feet below normal pool. The west abutment and all piers will be founded on rock, while the east abutment will be supported by steel bearing piles. The abutments will be included with the adjacent grade and drain contract; the piers will be included in a separate contract as will be the super-structure.

The completion date for this Project has been set for November 15, 1965, and all schedules being made at this time are geared to this date. The present plan is to let all the grade and drain work in April and May with completion dates in the spring of 1965. Surfacing contracts will be let in time to permit stockpiling of aggregates this fall and winter, with actual paving to start as early in the spring as possible.

The time alloted for construction is a bare minimum, as is the time for design. Past experience on the Parkway projects indicate that with adequate equipment and organization such a schedule can be met.